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SOIL CONSERVATION

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THE C. C. C. IN SOIL CONSERVATION

By Robert Fechner

Director Emergency Conservation Work

Mr. Fechner.

Two hundred years have elapsed since Jethro Tull, then an obscure British agriculturist, wrote his famous "Essay on the Principles of Tillage and Vegetation" to start a new trend in land use. The first President of the United States, on his death bed, had foresight to pen final instructions for prevention of soil losses on his three farms.

But the present mode of curbing soil erosion is decidedly new. It was not until establishment of the Civilian Conservation Corps and the Soil Conservation Service in 1933 that a vigorous step was taken in this direction.

At that time the Civilian Conservation Corps was an experiment. It was but natural that many communities should look a bit askance at these sprawling tar-paper buildings which began to dot the country. Many communities expressed doubts as to the advisability of having 200 young C. C. C. men established in the vicinity. In some quarters the question was raised as to the actual value of the type of work which the C. C. C. had been organized to perform.

It took only a few months, however, to convince the Nation that the C. C. C. was a worth-while organization. As the success of the first few camps became generally known, demands for the approval of new C. C. C. projects began to come in huge numbers to the Office of Emergency Conservation Work. For 2½ years there has never been a time when we could begin to supply the demand on the part of communities for C. C. C. camps.

During the past 18 months, a million and a half young men have left the ranks of the unemployed to

A noonday halt. These C. C. C. boys, in Ohio, planted many thousands of trees used for erosion control. Approximately 250,000 pounds of black walnut, hickory, and oak were seed-spotted during the past season east of the Mississippi River.

enter the Civilian Conservation Corps and engage in conservation work. At first these camps were assigned largely to forest and park-improvement projects. Since then the scope of the work has been broadened to include large-scale soil-conservation work, reclamation, grazing, and mosquito-control projects, wildlife-conservation activities, flood-control and drainage projects. In all these fields substantial conservation work has been completed. Our greatest accomplishments have been in the improvement of forest stands, the development of protective facilities in our forests and parks, the improvement of timbered areas for recreational use, and the prevention of soil erosion.

Early Camps

The C. C. C. and the Soil Conservation Service joined hands in April 1934, when 22 camps were allocated to what was then known as the Soil Erosion Service. These camps, located on 14 demonstration areas in regions where soil erosion presented a critical problem, and where there was an urgent need for the type of labor these camps could supply, were augmented by 12 of the 172 new 200-man camps established during the drought-relief period.

Popular approval given to the work accomplished by these camps assured their continuance and the assignment of 17 additional camps to the battle against soil erosion. Today, 501 of the 2,500 C. C. C. camps are being operated under the technical supervision of the Soil Conservation Service. The number of C. C. C. enrollees actually at work in the soil-erosion camps has more than doubled in the past 3 months.

Soil-erosion control work has come to be greatly appreciated in farming areas, and projects completed are already serving as valuable demonstration areas to farmers and landowners. Some idea of the work that had been completed through July 31, this year, is shown in a recent report compiled by the Bureau of the Census from figures forwarded to Washington from the various erosion-control camps. These records disclose that 1,315,255 temporary check dams have been completed in the course of carrying out the gully-control program. Other gully-control work included the planting of trees over 45,000,000 square yards of eroded lands, the seeding or sodding of 3,700,000 square yards of eroded land, the digging of 4,068,000 linear feet of ditches, and the sloping of 129,372,000 square yards of banks. About 2,000,000 acres of land have been covered in the gully-control work.

While Civilian Conservation Corps workers do not make a practice of actually constructing terraces in connection with the soil-erosion prevention program, they construct the necessary outlets. Since the program began more than 36,000 temporary and permanent terrace outlet structures have been constructed by the C. C. C. boys. More than 1,000,000 linear feet of outlet channels have been completed to date. The planting of trees and other vegetation for the purpose of preventing soil wastage has been one of the important erosion control activities.

It is estimated that more than 50,000,000 trees have been planted in connection with the soil erosion prevention program.

Just what will this expanded program mean to the Federal campaign for soil conservation? It will mean that soil conservation will be advanced far beyond the fondest hopes of a year ago. It will mean that the program will be extended to many regions where erosion is a critical problem, which could not be included in initial plans.

The work of the soil erosion C. C. C. camps has been largely restricted to gully control. Plans for the future have been broadened to include almost every type of approved erosion control—and it should be borne in mind that, while these camps are operating on private land, the purpose is not primarily to benefit the owner of the land but to demonstrate to every landowner in the region just how he may help himself.

What Is Ahead

The 501 camps under the Soil Conservation Service expect to treat in the next 12 months, more than 6,000,000 acres of farm lands now suffering soil losses from water or wind erosion or both.

In this expanded area, they plan to build more than five times as many check dams and other gully-control structures as were built during the last 12 months. A total of 348,808 dams were constructed during the past year. Plans include the construction of more than 1,800,000 check dams in the 39 States in which the camps will operate. These gully-control structures are to be supplemented by more than 1,500,000,000 square yards of seeding and sodding, and 120,000 square yards of bank sloping.

Reforestation of denuded slopes, lands too steep for safe cultivation, will also be a major activity. Preliminary surveys of the Soil Conservation Service estimate that more than 425,000,000 trees will be planted, com-

"Before and after"—Above, a bulldozer poised at the edge of a 46-foot-deep gully on a farm near Tigerville S. C., as it begins sloping the right bank. Below, the task nearing completion

C. C. C. men building a log check dam in Illinois.

pared with 30,446,500 trees planted on denuded slopes and in gullies during the preceding year.

Comparative figures such as these could be continued, to show the proposed work in terrace-outlet and outlet-channel construction, in diversion ditches and dikes, in rock quarrying, in seed collection, and nursery planting—but the few figures already given should afford a good idea as to just what the expanded C. C. C. program will mean to soil conservation.

There is another side to the program which deserves mention. As the new C. C. C. camps have been set up, enrollees of proved ability have not been forgotten. Where possible, foremen for the new camps have been recruited from the ranks.

Equipped by Experience

Not long ago, an ex-C. C. C. enrollee applied for a job to a construction foreman. The foreman pointed to a huge gully.

"Can you build a bridge across that gully?" he asked.

"Sure", was the calm reply. That has been exactly the kind of work this enrollee had been doing in a soil-erosion camp. He built the bridge, and was placed in charge of a crew. He had learned his stonework from building check dams in his former camp.

The Civilian Conservation Corps owes its popularity to the fact that it is doing worth-while work in the fields of youth rehabilitation and conservation. The thousands of letters received from States and local communities testify to the value which the country places on the C. C. C. work. One need only look at the bronzed lads working in the fields to see what the movement has done for them.

I am convinced that this work should go on. It is a type of work that has been generally beneficial to the entire community and in the development of our forest and park areas for recreational enjoyment we will be offering all of our citizens opportunities that only a few of them have hitherto enjoyed. Through the development and improvement of our forested areas we will preserve for future generations one of our most important natural resources. By continuing the work in soil conservation we can make an important contribution toward assuring future generations an adequate food supply.

Because a real service is being performed that not only is helpful to those directly engaged in it but offers opportunities not previously available to millions of our citizens, I am firmly convinced that the C. C. C. has fully justified the faith reposed in it and that it is returning a value in full proportion to its financial cost.

Poor land breeds shiftlessness and we shall spread rural slums throughout the Nation unless we do something to save it from degeneration. It is not necessary to have any illusions about changing human nature to feel that the rural poor must be helped. In the national interest we ought to give such of them as we can a chance to better themselves and to raise their families by decent standards of citizenship.

This is the direction in which conservation must now be turned. . . . To save the land and the people who depend on it is an aspiration in which all of us, it seems to me, can join.—From an address by Rexford G. Tugwell, Undersecretary of Agriculture, before the 50th Anniversary of the Founding of New York's Forest Preserve.

When we learn to use submarginal land for the purpose to which it is best suited, the true value of the area will be revealed, and such territory will take its rightful and worthy place in the world of agriculture.—Western Farm Life.

MEETING THE MENACE OF OVERFLOW WATERS

By Henry M. Eakin

Specialist in Sedimentation Studies

Comprehensive flood control includes not only the simple confinement and guidance of waters but control of erosion and the transportation and redistribution of sediment as well. Under such a composite practice the aims of river improvement can well look to an economic extension of flood control over the Nation as a whole, more real and permanent security of lands already temporarily benefited, and the gradual recovery and improvement of lands now condemned to damaging overflow.

The average annual direct flood damage within the United States outside the Mississippi Valley has been appraised at about $35,000,000. For the Mississippi Valley the future of flood damage is problematic, owing to the extensive improvement works now under way. In addition to direct property damage, account should also be taken of impairment of values, due to flood menace and deferred development of large areas of potentially high-value lands.

Influence of Upland Erosion

Erosional denudation of uplands decreases percolation of water into the ground and materially increases the volume of run-off from rainfall. Gullies extend open channels and abnormally steep headward slopes toward divides and induce abnormally rapid inflow of water from periphery to center of watersheds. This tends to give abnormally high and steep fronted flood waves and new orders of flood discharge.

Upland erosion also produces abnormal volumes of erosional waste which trunk streams are compelled to handle and distribute. Streams thus overloaded tend to shoal their channels and flood their valleys to progressively higher levels under given discharge. Man-induced erosion thus tends to increase flood heights by increasing flood discharges and decreasing discharge capacities of streams. Control of upland erosion offers large and essential results toward basic, permanent flood control.

Headwater Reservoirs

Flood discharges can be reduced in favorable cases by temporary storage of flood peaks in headwater reservoirs and valley-detention basins. These measures are admirably adapted to many small river projects. However, their possible proportionate reduction of flood discharges decreases as the size of the affected river becomes larger. For very large river systems their effects are relatively small and costs high. Such reservoirs and basins tend to fill up with sediment and lose capacity, particularly in regions of accelerated and uncontrolled erosion.

Levees

Levees are direct means of raising flood levels in order to restrict their lateral spread. A measure of protection of portions of the valley lands is thus directly afforded.

Levees in large river valleys have little effect on the rate of total sedimentation. They do, however, restrict deposition to the relatively narrow zone between the levees. This gives a higher rate of increase in depth of deposits and a smaller cavity than the whole valley to be encroached upon by sediment accumulation. As flood levels rise levee grades must be correspondingly elevated to maintain a safe margin of levee freeboard. Such elevation is toward a practical limit set by backwater encroachment upon lands sought to be protected and foundation conditions of the levees themselves. In long alluvial valleys sedimentation eventually raises flood levels higher than it is practicable to maintain a levee system. This fact was the eventual doom of the old "levees only" theory and practice on the Mississippi.

Revetment or Bank Protection

The protection of caving banks by revetment prevents normal replenishment of stream load with fine-grained materials to compensate bar deposition. Subnormal volumes of load are induced in lower reaches of the river and the rate of total valley sedimentation is increased. At the same time the channel is denied normal addition of new cavity area to compensate encroachments of growing bars. The effects of revetment on flowage conditions tend to increase the height of floods. General revetment of a large alluvial river receiving coarse-grained erosional waste from tributaries can be attempted only at disastrous expense and critical aggravation of floods.

For the directly intended purpose of protecting lands from caving into the river revetments are effective, but justified only where property values are exceptionally high or where local features of river alinement are essential to equally important engineering purposes.

Floodways

The practice of diverting portions of flood discharges through auxiliary floodways past regions of deficient main-channel capacity directly effects a lowering of flood stage. While in action such outlets increase sedimentation downstream from the point of egress of water from the main stream. Where outflowing waters lose velocity due to spreading and backwater effects, sedimentation is again favored.

The deposits in both of these situations tend to restore initial flood elevations.

The general rate of valley sedimentation and progressive flood elevation between the levees is but little affected.

In general, valley floodways are extremely expensive in lands—usually the best quality lands of the valley were they not condemned to periodic overflow. Where large discharges are diverted over essentially flat terraine the practice becomes in reality one of selective flooding rather than true floodway protection of lands.

Channel Contraction

The practice of channel contraction makes use of both solid and permeable dikes, wing dams, retards, training walls, and other structures and seeks to induce a deepening of the stream channel at the expense of its width. The purpose of these is improved navigability with minimum harm to flood control. In their readjustment to contraction works, stream channels lose cross-section area through induced accretion to bar and bed deposits and gain area in the region of the low-water channel. The process of gain in cross-section area lags behind that of loss with respect to time and is less in ultimate amount. The net effect of channel contraction, therefore, is quite generally a reduction of flood-discharge capacity and higher floods.

Cut-offs

The direct hydraulic effect of cut-off of a river bend is to reduce flood levels upstream and increase them somewhat in succeeding downstream reaches. Erosional readjustments following cut-offs tend to distribute these changes of flood elevation more widely up and down stream. Sedimentation is effected through increase in delivery of coarse-grained materials downstream. A number of cut-offs at the same time tend to combine in erosional effect and lead to material shoaling and widening of the channel in downstream reaches. Where levees are already raised to their practical limit these changes in channel form and flood elevations below cut-offs may be critical.

In nature the sedimentary effects of cut-offs are compensated by increased bank caving and resortment of debris which tend to maintain channel capacity at lower elevations. Where revetment of banks is practiced along with artificial cut-off of river bends, adverse channel readjustments and higher flood levels are doubly invited.

VOLUNTARY ASSOCIATIONS

Up to December 15, 22 memoranda of understanding between the various State extension services and the Soil Conservation Service had been approved. Additional memoranda were pending.

Articles of association for voluntary groups received in Washington as of December 15 follow:

Alabama, 11; Arkansas, 33; Idaho, 1; Illinois, 18; Louisiana, 21; Mississippi, 10; New Jersey, 3; New Mexico, 1; New York, 3; North Carolina, 10; Oklahoma, 29; South Carolina, 14; Tennessee, 5; Texas, 38; Utah, 1; Virginia, 9; Washington, 5; Wisconsin, 8.

Pioneering in organization of this type of association even prior to issuance of the report of the Secretary's Committee on Soil Conservation were W. A. Rockie, regional conservator, and A. L. Hafenrichter, regional nurseryman, Pullman, Wash. They filed articles, subsequently revised in accordance with the report, under which five associations got off to an early start in this important phase of the soil conservation program.

With 501 E. C. W. camps engaged in soil conservation work in 39 States, it is probable that a number of additional voluntary associations had been formed for which articles of association had not been received.

State advisory committees had been organized in the 48 States. In most States they had held one or more sessions and the State programs were reported well under way.

SEED COLLECTED IN LARGE QUANTITIES

Approximately 3,000,000 pounds of tree and shrub seed, in addition to 1,000,000 pounds of grass seed, have been collected by the nursery section of the Soil Conservation Service.

The grass seed, together with quantities of acorns, walnuts, and hickory nuts, will be planted on demonstration projects. Most of the tree seed is, however, for nursery planting. Collection of the latter was largely accomplished by relief labor and enrollees of the Civilian Conservation Corps.

Far West Did Well

Although Ohio, Pennsylvania, and other areas contributed to the success of black-locust-seed collection special honors in this important phase of the program go to Dr. A. L. Hafenrichter, regional nurseryman, and W. A. Rockie, regional conservator, and his staff at Pullman, Wash. Virtually no quantity collections of locust seed had previously been made in the intermountain region, but on November 29 the prospect was favorable to obtaining the entire 100,000 pounds of clean seed requested of the area.

Jack pine cones collected by W. P. A. labor in Crawford County, Mich.

Notwithstanding the fact that the black locust is native in the United States, most of the seed of this tree used by the Service in the past 2 years was purchased from Europe. Such importations always carry the risk of bringing some new pest into the country and are, therefore, frowned upon by pathologists and entomologists. By collecting the seed in this country, many thousands of dollars have been kept at home, the disease danger has been minimized, and a new local industry, collecting locust seed, has been developed in Idaho, eastern Oregon, and Washington.

Black locust seed in a warehouse at Zanesville, Ohio, December 15. Part of quantity collections by W. P. A. and C. C. C. labor.

DEVELOPING MACHINERY FOR HARVESTING BUFFALO GRASS SEED

By Guy C. Fuller

(The second of two articles on the development of machinery for the harvesting of grass seed)

The story of how thousands of acres of valuable native grass sod were turned under with the plow to grow $2 wheat, and later abandoned, is a tragic part of our agricultural history. Drought and dust storms have brought home to Great Plains farmers the need of reestablishing a covering upon this vast acreage that will successfully resist the onslaught of sun and wind.

At the Colorado Springs conference referred to in a previous article, each project manager was requested to estimate the quantities of native grass seed that he could use profitably in his area. Buffalo grass (*Buchloe. dactyloides*) led the list with 105 tons. The size of this total indicates the importance of the grass.

First assembly of vacuum machine designed for harvesting buffalo grass seed. Operated by gasoline engine and transported on trailer.

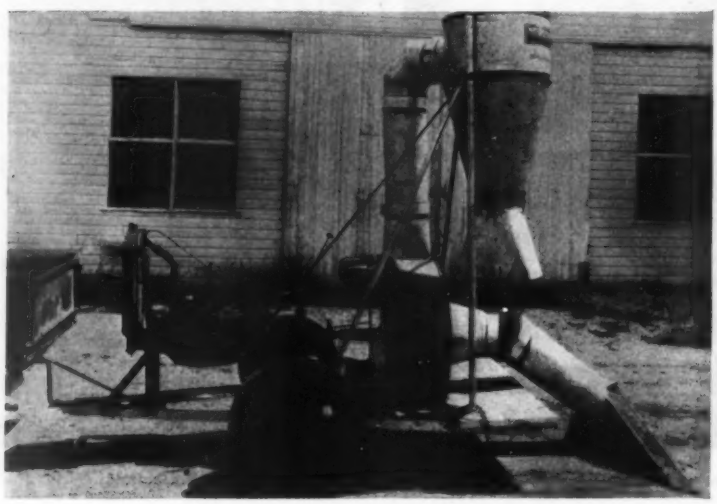
Drought Resistant

Buffalo grass has demonstrated its drought resistance and its ability to stage a comeback with the return of favorable conditions.

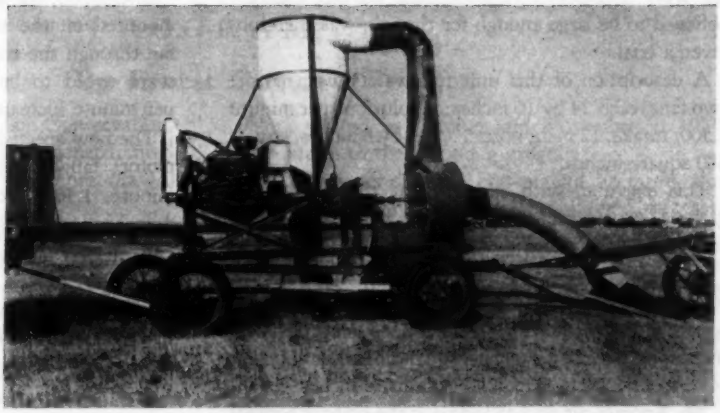
It is palatable and highly nutritious at all stages of growth. It is widely adapted to soils and climatic conditions, and may be propagated by seed or vegatatively with pieces of sod.

The stolons or runners reach out and fasten themselves down at the nodes. This method of propagation tends to increase the percentage of ground cover, to supply more grazing, to smother weeds and to protect the ground surface. The result is better pasture and soil protection. The idea of establishing the grass vegetatively has been considered and tested, but the method is expensive and sod is not available in sufficient quantities.

In Buffalo grass pastures both male and female plants are found, the female bearing the seed. These plants are not evenly distributed, but occur in patches of



Buffalo grass seed harvesting machine of the vacuum principle assembled at Kansas State College, Manhattan.



Buffalo grass seed harvesting machine of the vacuum principle assembled at Hays, Kans.

varying size. In an area where female plants predominate, a concentration of seed is found; whereas in an adjoining area the male plants may predominate and little, if any, seed can be obtained. Such a condition makes it difficult even to estimate the yield per acre.

Seed is produced throughout the growing season from early summer until frost. While there is, therefore, no definite harvest season, the largest quantity of seed may be obtained in the fall or late summer.

The caryopsis is in a small burr produced on the stem down among the curly grass blades. The burr is of tough fibrous material made up of one or more parts, usually two or three; each part may or may not contain a caryopsis. On one end of the burr are small, pointed, spreading projections which cause the burr to cling to the grass blades. As these small burrs mature and dry, they fall to the ground or drop at the slightest jar. Preliminary germination tests made by Government and other seed laboratories show a germination ranging from 5 to 65 percent. With these facts in mind we come to the problem of harvesting.

Perplexing Problem

The job is not simple, as in designing a machine nothing may be incorporated that would in any way damage the pasture. The idea of a vacuum device was first tried out at Chillicothe, Tex., in the fall of 1934. The test was inadequate and, so far as I know, the invention was not developed further.

The problem of a practical seed harvester was presented to Frank J. Zink, associate professor of agricultural engineering at Kansas State College, and L. C. Aicher, superintendent of the experiment station at Hays, Kans. The former had developed a machine of promise, and the latter had been thinking along the lines of our need. Buffalo grass pastures were readily accessible to both men for trial tests.

Because of the seeding habits and plant characters of Buffalo grass, it could not be determined in advance just how difficult it would be to gather the seed. Changes in the mechanism were based upon general observations, and it was not until a reasonable degree of efficiency was reached that accurate records were made of its performance.

Specifications of the Manhattan machine follow: Power, tractor power take-off; automobile transmission; fan, 24 inches by 8 inches; revolutions per minute, 1,000; intake pipe, 8 inches; nozzle, 5 feet by 8 inches, equals 480 square inches.

This contraption was mounted upon a 2-wheel trailer, and a dust-collector was added.

Chain Drag Tried

An examination of the ground and plants before and after operation of this machine indicated that a small percentage of the seed had been gathered. It was clear that the seed must be loosened from the plants and from slight imbedment in the soil. To accomplish this end, a chain drag was suggested. This side wall chains used on automobiles, about 3 feet long, were nailed about 1 inch apart to the 2 by 4 and attached ahead of the nozzle.

By this means many more seed were loosened, but still the machine did not lift the seed. It was concluded that a greater volume of air and increased veloc-

ity were necessary. A home-made furnace cleaner, believed to be large enough for the job, was therefore given a trial.

A description of this unit follows: Power, motor; two fans, each 24 by 10 inches; revolutions per minute 1,500; intake, 12 inch; nozzle, 5 feet by 8 inches, equals 480 square inches.

This machine, with and without the chain drag, gathered considerably more material but the percentage of seed taken up continued to be small.

At this point four new nozzles were designed, of the following dimensions: (1) 5 feet by 8 inches, equals 480 square inches; (2) 8 feet by 8 inches, equals 768 square inches; (3) 6 feet by 4 inches, equals 268 square inches; (4) 6 feet by 2 inches, equals 144 square inches.

No. 3 nozzle cut on a 45° angle at the point of contact with the ground. This nozzle was constructed of wood, tongue and groove material. Into one side a 12-inch pipe was fitted, adapting it to the pipe on the furnace cleaner.

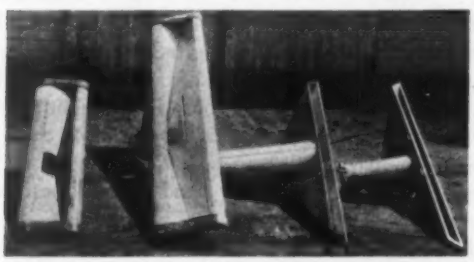
Results Better

The results were much better with this contrivance. More foreign material was collected and more than 50 percent of the seed was taken up.

To determine the proportion of seed lifted by the machine, small rectangular areas were marked off on the ground with a blunt tool or pencil and the seed in the area counted before and after the machine was passed over it. No attempt was made to have all areas the same size; they varied from 4 to 144 square inches.

With the machine approaching expectations, the wooden nozzle was attached to the first machine.

The percentage of seed obtained then was arrived at in the same manner as before. Approximately 30 percent was taken up, indicating that more power and a greater volume of air with increased velocity was required.



Types of nozzles used on vacuum machines constructed at Manhattan, Kans.

Thereupon, the fan was increased and a power unit mounted on the trailer and hooked directly to the fan through the transmission. This allowed the forward speed to be reduced and the fan revolutions per minute increased.

The new specifications read: Power, 4-cylinder gas motor; fan, 3 feet by 12 inches; revolutions per minute, 1,500; intake, 12 inches; nozzle, 6 feet by 4 inches, equals 288 square inches.

With this arrangement, 57 percent of the seed was picked up where too much top growth or foreign material did not interfere. That the efficiency of the machine is determined by the amount of top growth present will be clearly pointed out after a brief description of a similar machine assembled at Hays: Mounted upon a 4-wheel trailer; pneumatic tires; power, 4-cylinder, 20-horsepower motor; automobile transmission; fan, 30 inches by 10 inches; intake, 12 transmission; fan, 30 feet by 10 inches; intake, 12 inches; brush, 7 feet by 18 inches, with 8-inch maple core, 3-inch opening for shaft, 5-inch flexible fibers, revolutions per minute about 150; fan revolutions per minute, 2,200; brush rotation, clockwise, driven from axle.

Considerable foreign material, but a very small percentage of seed was picked up.

With the brush reversed and its revolutions increased to 350 per minute, using a nozzle 7 feet by 6 inches (504 square inches), the volume and velocity of air was not enough to clear the nozzle of heavy foreign material, principally cactus and cow chips which clogged the nozzle and did not allow lighter materials to be passed.

By removing the brush and attaching a 6-inch rubber belt to the back side of the nozzle, a better suction was maintained over slight depressions in the ground. Counts made as before showed approximately 40 percent of the seed taken up.

The belt was removed, allowing more air to pass under the back edge of the nozzle. This increased the efficiency of the machine about 8 percent. The machine was not yet meeting our needs, so the number of square inches in the nozzle was cut from 540 to 288 at the point of contact on the ground. This was done by fitting two pieces of wood inside the nozzle 18 inches from each end and sloping them toward the intake pipe. Counts indicated that this

(Continued on page 13)

BUILDING TERRACES TO FIT THE ROTATION PROGRAM

By Ernest Carnes

Within the next year or two the Soil Conservation Service will test the practicability of constructing terraces in South Carolina with ordinary horse-drawn equipment.

It is estimated that it would require the services of 100 tractor units 20 years to construct all the farm terraces that are needed in the Piedmont section of South Carolina.

Although terracing is but one of the control measures in the coordinated soil conservation program, it is highly important because of the fact that such a large acreage is devoted to clean-tilled crops.

Recently the S. C. S., in cooperation with technicians of 14 E. C. W. camps, located approximately 50 demonstration fields on farms of cooperators in South Carolina, of from 5 to 30 acres each, well suited to the proposed system of progressive terrace construction with horse-drawn machinery. Fields not badly gullied and with slopes of from 3 to 8 percent were chosen, leaving the steeper inclines for power outfits.

Plans for water disposal were made by engineers or erosion specialists. Terrace lines were established. The cooperator used implements common to the average farm, such as a two-horse turn-plow with three mules to pull it. An extension moldboard is, however, more satisfactory. The plow should be heavy enough to penetrate the subsoil.

Several Plowings Necessary

It is estimated that it will be necessary to plow up these ridges four to seven times to gain the necessary height and width for a satisfactory terrace. Special attention should be given to building up low places in the terrace ridges. This work will be done by the farmer himself over a period of 2 to 3 years, covering a complete rotation.

If the method is to be successful, the cropping system must be planned so that the maximum amount of vegetation will cover the fields during the early stages of construction. In order not to disturb the usual rotation of cotton, grain, and corn, terrace construction will be begun during the fall when grain is to be planted.

Work started in October and November of 1935 will conform to the following program:

(1) The water-disposal system will be made, the terrace lines surveyed, the terraces plowed, and the entire field sowed to oats, barley, or wheat.

(2) In February or March 1936 lespedeza will be sown between the terrace ridges on the grain, but not on the ridges.

(3) The grain will be harvested in June 1936, and the ridges plowed again. This will not disturb the lespedeza. The terrace ridges will be sown to sorghum or Sudan grass for hay.

(4) In the fall of 1936 the hay crop will be harvested from the ridges and the third plowing will be done. The ridges may be sown to a winter cover crop of grain, vetch, or Austrian winter peas. The lespedeza may be harvested for hay or seed and the stubble left for winter protection.

(5) In April or May 1937 the fourth plowing will be done, plowing under the cover crop, and planting to a summer hay crop. The area between the terrace ridges (lespedeza sod) will be plowed under and planted to corn, interplanted with soybeans or cowpeas.

(6) During the fall of 1937 the hay crop from the ridges will be harvested and the fifth plowing of the terrace ridges will be done.

(7) In the spring of 1938 the sixth plowing of the ridges will take place, after which the entire field, including the terrace ridges, will be prepared and planted to cotton, the third and last year of the rotation cycle.

There are a number of advantages to this method of terrace construction:

(1) No initial cash expenditure is involved.

(2) With the exception of the "panning-up" of low places, no extra labor is required, as the land must be plowed anyway.

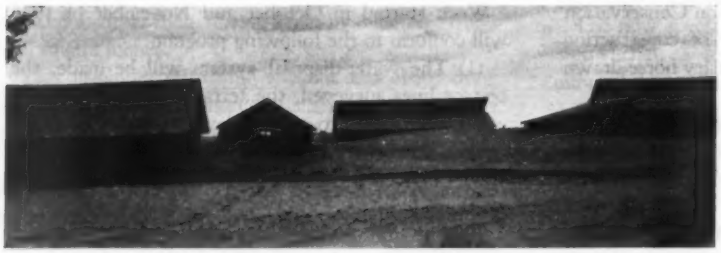
(3) The maximum vegetation is had at the time when the terraces are least effective.

(4) The rotation system is not disturbed, providing the terracing is started concurrently with the grain in the rotation cycle.

(5) A sod is turned under at each plowing, which will result in more substantial terraces.

ENGINEERING STRATEGY IN A WIND-EROSION AREA

By L. C. Tschudy



A result of wind erosion.

Our engineers have their work cut out for them here in the drought-scourged, wind-whipped expanses of the Dakotas. But in valuable partnership with them, and with the other soil-conservation specialists engaged in the erosion-control and water-conservation program, is the indomitable spirit of a people who will not be beaten by repeated disaster. They have farmed with energy and a faith which literally has "moved mountains"—mountains of sand piled against barns and houses and fences, obliterating roads and bringing desolation to thousands of acres of a once productive agriculture. Their wives and daughters have patiently "swept out" following innumerable dust storms, loyally seconded their men in facing the future with hope and courage.

Dakota farms will continue to make crops. Hereafter when the rain fails and the winds blow, many of them will remain anchored and drought-resistant because of engineering devices used in supplementing agronomic measures of wind-erosion control. Briefly, I will sketch what we are doing.

Procedure Outlined

First the farm is visited by a Soil Conservation contact man. He works out a new plan, revises the rotation system with an eye to cover crops, provides for strips laid at right angles to prevailing winds. Soil drifts must be leveled, seeding must be followed by listing. There may be need for level terraces to conserve water or for a small water-conservation reservoir. In any case, if the farmer needs such work and offers his cooperation, the Soil Conservation Service will carry through the job. The contact man makes a detailed report for the engineers, gives a rough estimate of what is required for retaining rainfall and resisting erosion.

The field engineering classifies as (1) leveling fields and preparing them for crops (2) level terracing for retention of water, and (3) small dam construction.

When our program began, we found that many fields had blown to such an extent that no cover crops would catch without a roughening of the surface. Huge drifts were collected along fence lines, a menace to wind-erosion control. Many of the fences were buried.

Smoothing the Ground

We are following the practice of using heavy equipment to level drifts—a tractor and blade. First we level these drifts up to the fence line, then remove the fence and level the other half of the drift. The fence is then replaced and the entire field is usually listed for seeding to rye, wheat or oats. Where movement of the soil is not so serious, cultivating and seeding will make a cover crop possible.

The general purpose of terracing is to assist in the control of water erosion. If our engineers decide upon this method of treatment, a soil survey is made for guidance.

When soil is of slow infiltration, water is likely to stand in the terrace for a longer time than is desirable. In such a case the terraces are made with a slight grade so that the water will flow off the channel before it drowns a crop. When, on the other hand, the soil is of fast infiltration, the terrace is designed without any grade. Thus a good part of the run-off will be stored on the field. In either instance, the water will be slowed down so that more of it will seep into the soil.

The ends of the terraces are left open. This provision is to avoid flooding of crops or over-topping of terraces. Later, if the farmer wishes to close these ends during

a dry season, that can be done. Our operations are conservative. If there is uncertainty as to whether or not the soil will absorb the moisture in sufficient time to prevent drowning of the crop, we make the terrace with a slight grade over the last 500 feet.

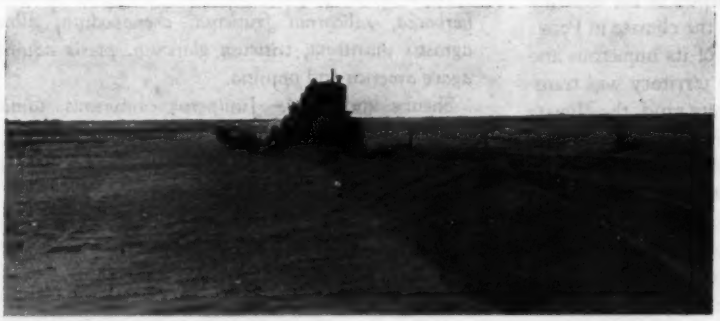
Cost Records Kept

Accurate cost records are kept throughout, including topographic map, survey, time, heavy equipment and finishing. W. P. A. labor is being used to advantage in the construction of dams. Cooperating farmers furnish sand and cement for rubble masonry spillways, teams and teamsters for placing the fills, or for plowing in preparation for fills. The Soil Conservation Service furnishes engineering supervision, investigation, and plans.

This arrangement results in the farmer sharing a good portion of the cost of each dam.

Small dams are very much in demand in this area, and the entire erosion-control program is looked upon with favor by a community that is determined to prepare for the next great drought.

Typical of the fence drifts.



Heavy equipment leveling drifts.

(Continued form page 10)

machine gathered about 60 percent of the seed. A this point, there was very little difference in the efficiency of the two models.

The consensus of opinion was that a much greater percent of the seed could be obtained if the top growth were mowed and removed. This had been suggested a number of times. To test the theory, a lawn mower with a grass catcher was taken to a pasture and small areas were clipped.

Summary

Machine	Nozzle	Treatment	Number of areas	Total seed	Seed left	Percent harvested
	Square inches					
Hays	540	Belt on nozzle [1]	[2] 4	152	91	40
Do	540	Belt removed	4	142	74	48
Do	288	Grass clipped, 1 inch.	5	249	13	95
Do	288	Clipped, 1 inch	5	103	28	72
Manhattan	288	do	4	104	33	68
Do	288	do	5	92	28	66
Do	288	Not clipped	7	240	103	57

[1] 6-inch rubber belt attached to rear edge of nozzle. An average of 34 counts indicates an overall efficiency of 63.7 percent.
[2] Number of areas in which counts were made before each test.

(Concluded on page 14)

HALTING ITALY'S SHIFTING SANDS

By Albert Chiera

(Pictures on Opposite Page)

EDITOR'S NOTE.—This article, like the one by the same author in the November issue, is presented solely in the interest of a broader understanding of erosion control practices. Soil science knows no international boundaries. Mr. Chiera is a translator and research assistant in the Soil Conservation Service, and his contribution is a by-product of extensive reading of erosion control literature.

Among the plants to which nature has assigned the task of restoring devastated land, the *Arundo arenaria*, or weed of the sand, is of particular interest. It can live partly buried in sand, with its roots exposed to hot winds. Moving sand is halted by this plant, forms small mounds around it; the roots seek the air, vegetate and repullulate near the surface, and check the migration of still other sand.

It does not follow, however, that this or any other plant will be able to reconquer the lost mantle of vegetation over desert areas without the help of man.

Experience of Other Countries

Egidio Ferrari in the second chapter of his Boschi e Pascoli states: "The change that the climate in Persia underwent after the destruction of its numerous and majestic parks is well known; its territory was transformed into movable banks of white sand, the climate became arid and suffocating, springs of water at first decreased and finally disappeared altogether. Egypt, with the devastation of its forests, saw a decrease in rains, in soil fertility, and in uniformity of its climate. Palestine, at one time covered with valuable forests and fertile pastures, possessed also cool and moderate climate; today its mountains are sadly denuded; the rivers almost dry and crop production reduced to a minimum."

It is clearly seen that the cooperation of man is essential to combat erosion. Some of our most useful plants are not native ones. For example, alfalfa, which is an Oriental plant, was brought to Greece from Persia about 590 B. C. and entered the United States of America from the West at the time of the gold discoveries.

Grasses alone, whether native or foreign, are often insufficient to stop wandering sand dunes. To secure permanent living cover, we also resort to scrubby shrubs, forest trees, and physical means. The fixation of drifting dunes by a special artifice is essential under extreme conditions.

The Italians, as shown in the upper picture on the opposite page, have found a way of solving the problem by imprisoning sand in fences placed close together, forming corridors within which forest plants are protected during the early stages of their growth.

In the lower view a similar principle is exemplified somewhat differently. A light fence is covered with living vegetation planted in squares which check the wind and hold the sand in place. Forest plants, whether seeded or transplanted are thus given an opportunity to live and grow.

Arnaldo Fanti in his book La Tecnica e la Pratica Delle Bonificazioni, gives in chapter VI a list and description of the plants found most suitable for this work. I quote this list herewith, believing that some of them, if indeed not already used, might be found valuable in a work of this kind in the United States:

Herbaceous plants.—*Arundo arenaria, salicornia herbacea, salicornia fruticosa, chenopodium album, agrostis maritima, triticum glaucum, pteris aquilina, agave america* and *opuntia.*

Shrubs and trees.—*Juniperus communis, tamarix gallica, pinus maritimus* and *pinua pinea.*

(Concluded from page 13)

Conclusions

1. Buffalo grass seed may be gathered with a vacuum machine.

2. Machines of this design will harvest from 50 to 60 percent of the seed under average conditions and will not damage the pastures.

3. For best results, pastures moderately to heavily grazed must be selected from which to harvest seed. A chain drag used on pastures of this nature will slightly increase the amount of seed obtained.

4. Mowing pastures will not be feasible because of added expense and lack of available pastures where mowing would be permitted even at rental prices.

5. The efficiency of the machine will be determined by the density of turf and how securely the seeds are embedded in the soil.

Above: Reforestation by **Alepensis** *pine.* *Below: Damming drifting dunes.*

BOOK REVIEWS AND ABSTRACTS

By Phoebe O'Neall Faris

A contribution from the Soil Conservation Service Library

REPORT OF H. H. BENNETT, Chief of the Soil Conservation Service, to the Secretary of Agriculture. September 26, 1935. Washington, D. C.

Reestablishment as a permanent bureau of the Department of Agriculture, assuring as it does the coordination and continuation of national effort to preserve soil resources, was, to the Service, the most significant development of the year. This transition from an emergency agency to a permanent bureau entailed reorganization and reshaping of policies, and at the same time a broad expansion of activities. Summarily stated, the objectives of the Service are, to propagate the use of soil conservation practices in agriculture through the medium of demonstration; in so doing, to effect a maximum control of erosion on as large a land scale as is possible; and to collect fundamental scientific facts essential to the development and improvement of soil-conservation method and technics.

As a functional approach to each of these objectives the program of the Service is divided into distinct but interrelated fields of activity, involving (1) the field demonstration work, (2) actual cooperative work with land owners, and (3) a consistent development and improvement of all measures through research and investigation.

Tables included in the report present the geographical and acreage distribution of projects, cooperative agreements, special field work completed, assignments to emergency conservation camps, divisional data resulting from surveys, and erosion wastage. Concise summaries of three important projects are given; namely, the Navajo, the Gila River, and the Rio Grande projects.

The report sets forth clearly the organization plan of the Service, with objectives and work of divisions, sections, units, their duties and interrelationships. A brief personnel and expenditure reconnaissance is included at the close.

MANUAL OF THE GRASSES OF THE UNITED STATES. By A. S. Hitchcock. United States Government Printing Office, Washington, 1935. 1,040 pages.

This is an accomplished and concise description of the grasses of the United States, with distribution and utility notations which make it particularly valuable to the practical botanist. There are 159 numbered genera and 1,100 numbered species. Many authentic sources have been utilized by the author in solving the problems of puzzling species and varieties.

Of special interest to the Soil Conservation Service are the soil-holding grasses which possess strong creeping rhizones. In Dr. Hitchcock's book are to be found illustrated descriptions of the most effective sand-binders, namely the European beachgrass (*Ammophila arenaria*) and its American relative (*A. breviligulata*); *Calamovilfa longifolia* and *Red fieldia flexuosa*, the native sand binders on sand dunes of the interior; Bermuda grass and quackgrass (*Agro-pyron repens*) used successfully to hold the sides of cuts and banks; and rhizone-bearing species of *Elymus* and *Agrophron*, which are efficacious in holding railway embankments along the Colombia River.

Grasses playing an important part in coverting marshes and mud flats into dry land, especially species of *Spartina* and *S. townsendii*, are described in detail and illustrated by fine drawings made from specimens. Many range and pasture plants are represented, as well as hay, silage, ornamental, soiling, and industrial arts grasses.

A useful feature of the book is its accented syllable markings to aid the user in pronouncing the Latin names.

At the close of the classification section appears a synonymy. For quick reference the names of genera and valid species are arranged in alphabetic order, the names in blackface type. The synonyms, in italics, are arranged chronologically under the names to which they are referred.

A glossary of botanical terms is included, and a most comprehensive index with synonyms in italic type.

This manual, the final work of the late Dr. Hitchcock, is a suitable monument to a great botanist.

We have in the Soil Conservation Service Library a limited number of copies of this book which may be taken on loan for use in the field.

USE OF IRRIGATION WATER AND IRRIGATION PRACTICES. VOLUME I. By B. A. Etcheverry and S. T. Harding. Second edition, 1933. 100 illustrations.

This is the first volume of a three-volume series, entirely rewritten for the second edition. The authors present the essential features of good irrigation practice, with sufficient material regarding the subjects to support the principles set forth. Results of individual experiments are used to illustrate the principles of practice. The book contains chapters on physical properties of soils; water requirements of irrigated crops; general water requirements; preparation of land for irrigation, and method of application; farm distribution systems, and the selection and cost of small pumping plants.

ELEMENTS OF FOREST MENSURATION. By Herman H. Chapman and Dwight B. Demeritt. 1932.

A new method of presenting this subject, with these conspicuous features: It begins with the product and its measurement, follows this product into the log or bolt, totals the contents of these pieces to obtain tree volume, shows how this volume can be measured in standing trees and finally discusses the problems of measurement of the product in a stand of timber and on large areas of land. 422 pages. Bibliography. Appendix. Index.

THE MODERN NURSERY. By Alex Laurie and L. C. Chadwick. 1931.

An up-to-date and thoroughly complete manual of the handling of plants as practiced in the present-day commercial nursery. 494 pages. Illustrations. Index.

U. S. GOVERNMENT PRINTING OFFICE: 1936